a short season for growth, and of a relatively high nutrient content. In connection with the heavier rainfall in June and July, the nutrient content of shortgrass land too often produces a deceptively luxuriant growth of crops, which are cut short by dwindling water content in late July and August.

The wiregrass association is dominated by *Aristida longiseta*. It is found chiefly on sandy loam, or at least on soils intermediate between the sandhills and the hard lands. The soil texture in wiregrass land permits greater penetration of rain, available water occurs deeper in the soil, and deep-rooted species become possible. The roots of wiregrass are from 2–3 feet long, while its usual associate, *Psoralea,* reaches a depth of 5 feet. There is nothing, however, to exclude the short-rooted grasses, and two species of grama often occur in this association. The wiregrass association indicates more favorable conditions for crop production than any other group. The soil is sufficiently compact to prevent blowing, and is well-supplied with nutrients. Water penetrates readily to a fair depth, and water loss is lessened by the air content of the sandy surface.

The soil of bunch-grass land is sand, and it allows rain to penetrate to a greater depth than either the hard land or the sandy loam. It contains more available water than these soils, but is relatively poorer in nutrients. Owing to its loose structure, it blows readily, and methods of cultivation must take account of this fact. The runoff from the sandhills is negligible, and the water loss from the soil surface slow, owing to the formation of a mulch of dry sand. The typical species of the association, bunch-grass (*Andropogon scoparius*), develops roots to a depth of 4–6 feet, as is the case also with its most frequent associates. The density of bunch-grass seems to be in direct relation to the water supply, and consequently a fairly close cover indicates a higher water content and better agricultural conditions. When the bunches are scattered, the short-grass finds an opportunity to establish itself in the spaces, utilizing the water content of the first soil foot.

The final vegetation type of the region is the shortgrass association, which may be reached through various successions. Of the two common primary successions, one begins with lichens on disintegrated rocks, passes into the *Gutierrezia-Artemisia* association, and as the soil becomes finer, terminates in the shortgrass association. The pioneers in a blowout initiate a longer succession. As a consequence of rendering the sand more stable, they yield sooner or later to a mixed association of sandhill plants, and finally to the bunchgrass association proper. The effect of fires or grazing is to change the latter to the shortgrass association, often through an intermediate wire-grass stage. When an association is destroyed by breaking the soil, the first vegetation will consist of weeds, but this will soon be replaced by the association which ordinarily precedes the one destroyed. For example, when short-grass is broken, *Gutierrezia-Artemisia* or wire-grass will take possession, to yield again to short-grass in the course of two or three decades, bunch-grass or other sandhill vegetation will temporarily replace wire-grass, etc. The cause of this is readily found in the loosening of the soil, while the reaction which brings back the original stage is seen in the increasing stabilization of the soil.

From the standpoint of crop production, the largest yields are obtained during favorable seasons from the shortgrass land, but failures are also most frequent on it. Bunch-grass land produces the smallest yield in good years, but on the other hand crop failures are rare. Because of its intermediate position, wiregrass land is usually the most valuable of all, since its productivity is not far below that of shortgrass land in good years, and it has much of the advantage of bunchgrass land in dry years.

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Blumen und Insekten, ihre Anpassungen aneinander und ihre gegenseitige Abhängigkeit. Von Professor DR. O. VON KIRCHNER.

Leipzig u. Berlin, B. G. Teubner. Pp. iv + 436, 159 figs.; 2 pls. 1911.

The large amount of literature which has been produced on the mutualistic relations of flowers and insects by Sprengel, Darwin, Delpino, Hildebrand, H. Müller, E. Loew, Chas. Robertson and numerous other investigators, and especially the recent publication of Knuth's exhaustive "Handbuch der Blütenbiologie" and its translation into English, would seem to render superfluous any further general presentations and to leave room, at least for some years to come, only for very special studies. An examination of von Kirchner's volume, however, shows it to be a very concise and useful compendium. The author presents the entomological aspect of the subject more fully than is usually attempted in similar works, one whole chapter being set aside for this purpose, after an introduction and two chapters on the meaning of pollination, the various ways in which it is brought about and the peculiarities of insect pollination, or entomogamy. Then follows a chapter on the general adaptations of flowers to insects. The bulk of the work is devoted to a concise and interesting discussion of the various types of entomogamy (Chapters VI. to XII.) according to H. Müller's classification of flowers into those which bear pollen only and those which produce nectar, and of the latter into various subgroups according to the accessibility of their nectaries or the peculiarities which make them specially attractive to Diptera, Hymenoptera or Lepidoptera. The ability of the author to present matters clearly and briefly is well shown in his account of the classical cases of the yucca moth and the caprification of the fig, while his balanced and temperate judgment finds expression in the three concluding chapters of the work, which deal with floral statistics, the causes of the mutualistic adaptations of flowers and insects and the various hypotheses which have been advanced to account for the phylogenetic origin and development of floral structures. That rare thing in so many recent German books, a good index, is added. The text is well-illustrated with a number of large clear figures, mostly from drawings by the author. A few of these figures, however, are open to criticism, for example, Fig. 16, which represents the abdomen of the bee *Osmia spinulosa,* is up-side-down, and Fig. 10, representing the olfactory organs of insects, is woefully archaic and should be replaced in a future edition by an up-to-date illustration. It is to be hoped that von Kirchner's work will be translated into English so that it may become more useful to students in the United States and inspire further observations on the mutualistic relationships of our native flora and insect fauna.

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SPECIAL ARTICLES

A NEW SPECIFIC GRAVITY BALANCE

The Specific Gravity of Minerals.—As the specific gravity is one of the most constant properties of minerals, its determination for pure massive specimens is one of the best means of identification. The accurate determination of specific gravity is a slow and painstaking process. A simple and rapid method which will give approximate results suffices for many purposes. The Jolly spring balance and a beam balance,[1] which depend upon the well-known principle of hydrostatics that a substance immersed in water loses in weight an amount equal to the weight of the water displaced, are fairly satisfactory. Two or three readings are made from which the value of the specific gravity is obtained by calculation. Though the calculation is simple enough it takes time and one is apt to make mistakes. The writer has designed a modification of the beam balance which it is believed will be found more convenient than these other forms, as the specific gravity is read off directly, the calculation being made once for all and recorded as graduations on the beam.

The New Balance.—The accompanying figure, which is one sixth actual size, shows the

[1] Brush-Penfield, "Determinative Mineralogy," sixteenth edition, p. 235. Geikie, "Structural and Field Geology," second edition, p. 428.